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ABSTRACT

This study examined student departure rates from the Faculty of Pure and Applied Science at York University in Ontario (Canada) using Tinto's (1987) model of student departure. Student records from 1992-93 were used to obtain data on grades in the final year of high school, sex, language status, and amount of student financial awards received; first-year grade point average and enrollment status after the first year were obtained from 1993-94 records. A total of 141 students also completed surveys regarding academic goals and attitudes. It was found that 78 percent of the students re-enrolled in the sciences for their second year, 5 percent enrolled in other faculties at the university, and 17 percent left the university for destinations unknown. In general, those who remained in the sciences had higher grade 13 and first year marks than those leaving the university; however, students leaving the sciences for other university faculties had higher grade 13 and first-year marks than those remaining in the sciences. Enrollment status in the second year could not be related to pre-entry characteristics or initial goals and commitments of students. An appendix explains the model of student departure. (Contains 28 references.) (MDM)

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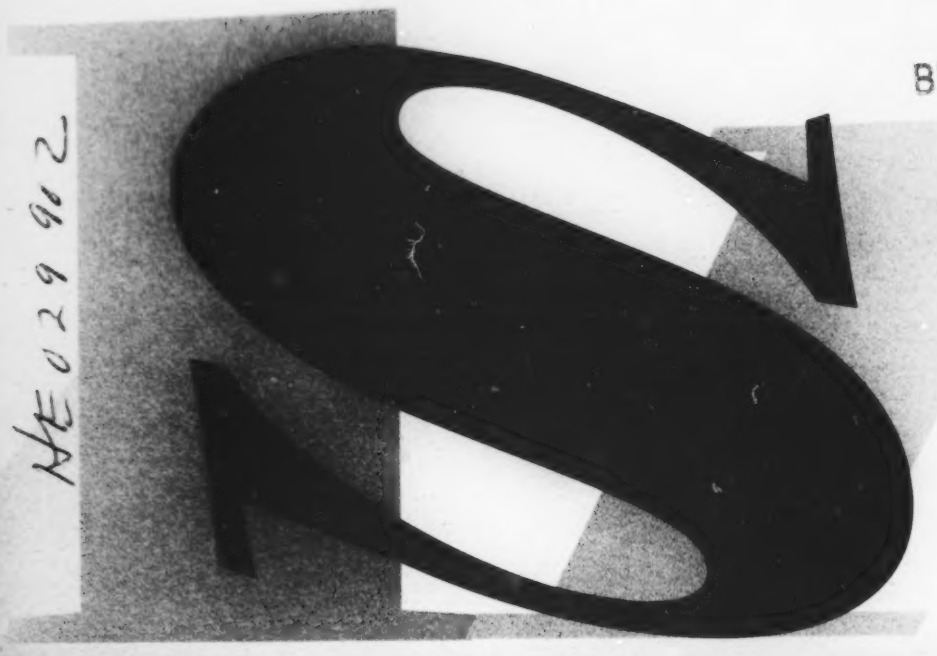
Who Leaves Science? - The First Year Experience at York University

J. Paul Grayson



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Who Leaves Science? - The First Year Experience at York University

J. Paul Grayson
Institute for Social Research

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Summary

In 1993-94, 78% of students who had been in the first year of their studies in the Faculty of Pure and Applied Science at York University re-enroled in the Faculty for their second year. An additional 5% migrated to other faculties at York and 17% left the University for destinations unknown. In general, those who remained in Science had higher grade 13[1] and first year marks than those leaving York; however, students going into other York faculties had higher grade 13 and first year marks than those remaining in Science. In addition, females were slightly over-represented among those leaving the University or going elsewhere in York. In addition, among those migrating to other York destinations, a disproportionate number stated that their mother tongue was other than English.

Tinto's 'model of student departure' was used as an organizing principle in an effort to understand processes that might have led students to remain in Science, to migrate to other York faculties, or to leave the University. In brief, Tinto argues that retention/attrition is a function of students' pre-entry characteristics; initial goals and commitments to education and the university; social and academic involvement in the University; and emerging goals and commitments over the student's career.

In the study of Science students at York based on administrative records and three surveys, it was found that enrolment status in second year could not be related to pre-entry characteristics or initial goals and commitments of students. While those remaining in Science tended to have higher degrees of academic involvement, differences were not statistically significant. While on some measures of social involvement those remaining in Science behaved in predicted ways, patterns were inconsistent and frequently not statistically significant. By way of contrast, student enrolment status in second year was significantly related to a number of goals and commitments that emerged over the course of the first year.

On the basis of the collected evidence it can be argued that Science is losing some of its highest first year achievers to other parts of York University and some of its lowest academic achievers are leaving the University. There is some evidence that individuals remaining in Science were somewhat more academically

[1] York's administrative records still refer to grade 13 rather than Ontario Academic Credit marks. As a result, grade 13 is referred to throughout.

involved than others and that their intention to remain was evident in their emerging goals and commitments. Elsewhere it has been argued that the Faculty of Pure and Applied Science could be doing more to increase the academic involvement of students and thereby perhaps increase academic achievement and decrease out-migration after first year.

Introduction

It is estimated that, on average, only 66% of Canadian science[2] students receive a degree in science from the institution in which they began their university career. With a completion rate of 68%, the track record for Arts students is only slightly better (Gilbert, 1991:12). Of students who do complete degrees, Statistics Canada found that two years after graduation only 36% of chemistry graduates had jobs directly related to their education. The comparable figures for physics, biology, and computer science graduates were 43%, 23%, and 59% (Employment and Immigration Canada, 1991:247).

While, on the one hand, employment prospects for science graduates in some areas of specialization are not very encouraging, on the other hand, Canadian policy makers consistently point to the need for more scientists and engineers if we are to meet the challenge of global competition. For example, in the **Report of the National Advisory Board on Science and Technology**, it is stated that:

> The overall picture in science, engineering and technology is bleak given the future Canada faces. If we are to catch up and remain competitive, consistent policies and programs in immigration, education, training and job creation are needed to encourage many more people and many more of the best and brightest, especially among women, to pursue careers in science, engineering, and technology (Human Resource Development Committee, 1991:26).

In the same report it is claimed that companies face difficulty in finding sufficiently qualified research and development personnel. Similar refrains are echoed elsewhere (Economic Council of Canada, 1991).

The laments of policy makers notwithstanding, given employment prospects, it is doubtful that serious damage is being done to the Canadian economy because of high attrition rates in science programs - there appear to be enough science graduates working in other areas of employment that can be drawn on to fill the needs of industry. (This situation is unlikely to change in the absence of an industrial strategy that now, in the era of North American Free Trade, is a virtual impossibility.) More important, perhaps, is that high attrition rates may

[2] 'Science' is capitalized throughout the text only where the term refers to a particular faculty.

represent the abandonment of science by some individuals who might otherwise have made a valuable contribution to specific fields or who would have found an undergraduate education in science a personally fulfilling experience.

The current report will focus on the 78% of first year students who remained in the Faculty of Pure and Applied Science at York University in 1993 after completing one year of their studies; the 5% who migrated to other York faculties; and the 17% of students who left the University for destinations unknown. It might be noted that the 22% who left Science for various destinations represents a comparatively low *first year* attrition rate at York; however, the four year attrition rate for Science is relatively high. For example, by 1992, 48% of science students, as compared to 38% of Arts students, who entered York in 1988 had withdrawn from their programs.

In examining Science students Tinto's (1987) 'model of student departure' will be used as an organizing principle. Although the model was developed on the basis of analyses of primarily residential campuses - York is a commuter university - it nonetheless identifies factors, and relationships among factors, that should be considered in a study of student retention and/or attrition. Details of the model can be found in Appendix A.

Data Sources

Data used in the current report on students who in 1992-93 entered the first year in the Faculty of Pure and Applied Science come from two main sources. First, student records were used to acquire information on: grades in the final year of high school; sex; 'mother tongue'; total amount of awards received in 1992-93; first year grade point average; and enrolment status in 1993-94. Second, all other information was collected in three surveys conducted on the second day of classes in September, in mid-November, and from the middle of February to the middle of March. Where possible, data from administrative records were linked to survey data.

The percentages of those responding to surveys conducted on the second day of classes, in mid-November, and in late February and early March were 89%, 84%, and 68% respectively. Among the respondents for each survey approximately 70% to 80% were willing to provide student ID numbers so that their responses to

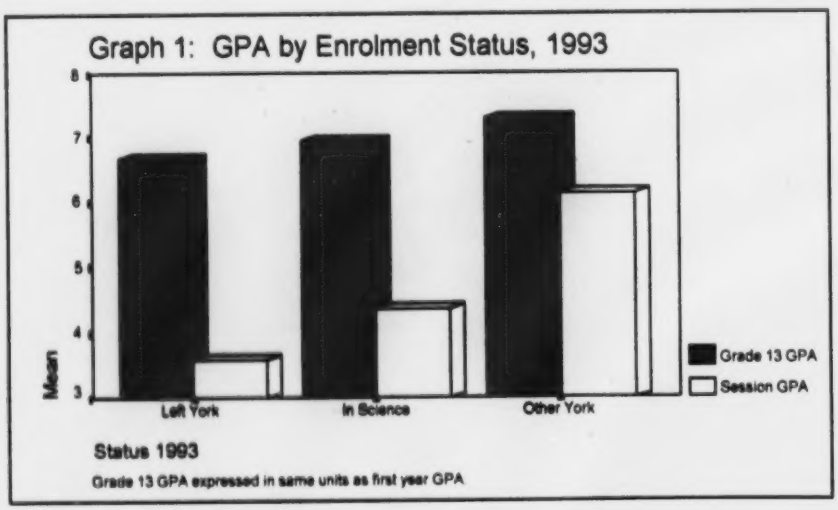
various surveys could be compared; unfortunately, it was not always the same students who provided information from one survey to the next. As a result, while the overall response rate to each survey was acceptable to high, only 141 students provided identification across all three surveys.

Who Leaves Science?

Administrative records indicate that in 1993-94 approximately 78% of those who enrolled in first year science in 1992-93 returned to Science. Seventeen percent left York, and 5% enrolled elsewhere in York. Of the latter, 48% went to the Faculty of Arts; 26% to the Faculty of Education; 15% to Atkinson; and 11% to Administrative Studies.

The grade 13 and sessional marks of each of the three groups are outlined in Graph 1. Because data are available for all science students, tests of statistical significance are redundant. As can be seen from the graph, differences in Grade 13 grade point averages for each of the three groups are slight. Nonetheless, students who eventually left Science for other York destinations scored slightly higher than others.

When sessional grade point averages are examined it is clear that those leaving Science for other destinations at York did far better in their first year than those remaining in Science and students leaving York. In turn, those remaining in Science achieved higher academic standing than individuals who left York. In essence, those who remained in Science did better than those who left York, but not as well as students who transferred to other faculties at York.



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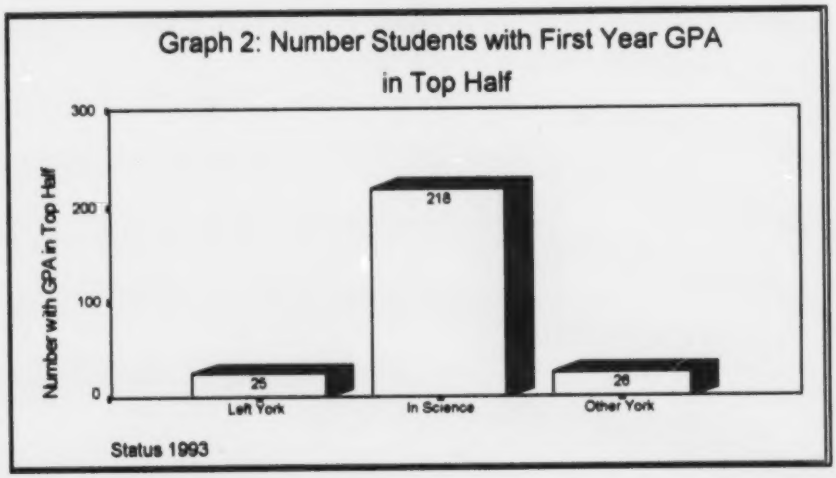
On first glance, it might be assumed by the Faculty of Pure and Applied Science that the only thing to be concerned with in Graph 1 is that some students with high first year averages move to other programs at York. Data in Graph 2, however, indicate that of students who left York, 25 (or 25% of those leaving York) had grade point averages in the top half of the first year class. It might be assumed that the faculty would like to retain such students. When the number of students leaving York is added to those enrolling in other York faculties, the total number of students leaving Science for various destinations totals 19% of all students who placed in the top half of the first year. Whether or not this figure represents an acceptable loss from the Science program cannot be answered here.

Other information available from administrative records indicates that whereas only 40% of students remaining in Science were female, 48% of those moving to other faculties and 44% leaving York were female. In addition, while 67% of remaining Science students and those leaving the University identified their 'mother tongue' as English, only 54% of students going to other York faculties made a similar claim. In essence, slightly more females than males are leaving Science; more students for whom English is a second language are pursuing studies in other parts of the University than those who continue in Science.



Overall, the data from administrative records indicate that after the first year, those who leave the Faculty of Pure and Applied Science are among the lowest and highest achievers in terms of first year marks. In addition, slightly more females than males leave Science and large numbers of those who leave York for other faculties have a first language other than English.

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Explanations for Attrition

So far analysis has focused on data housed in administrative records that are available for every student who enrolled in first year Science in 1992-93. This tack was taken so that the reader would be provided with the maximum amount of information on certain characteristics of students; however, a serious examination of some of the reasons for, and processes underlying, retention and attrition requires an analysis of data more in keeping with Tinto's model identified earlier. Unfortunately, data in administrative records are insufficient for this purpose. As a result, data collected in the three surveys discussed previously must also be used. As stated earlier, the number of cases available from the surveys is fewer than those included in the administrative records.

Pre-Entry Characteristics at York

Data on pre-entry characteristics, that might affect attrition/retention rates, are summarized in Table 1.[3] The largest single percentage of students in each group come from families with middle incomes - $50,000 to $99,999; nonetheless, students who leave for other York faculties are disproportionately drawn from this income category. Unfortunately, for this table, the numbers in the 'Other York' category are too few to allow valid statistical analysis. If this column is removed, and only those who leave York and individuals who remain in Science are examined, it is clear that there are no large differences in average family incomes.

If data on fathers' education are examined, it would appear that none of the three groups under consideration come from families in which the majority of fathers have completed the equivalent of a college/university education. However, 45.7% of the fathers of those leaving York as compared to 31.6% and 33.3% of those staying in Science and moving to other York faculties respectively, report college or more for their fathers. Based on chi-square, however, differences are not statistically significant.

Table data also indicate that the majority of students, independent of their status in 1993, have mothers who do not have a college education. Any differences

[3] Technically, tables should be percentaged in the direction of the independent variables; however, because of large differences in the absolute sizes of the 1993 enrolment categories, following this practice would have made meaningful analysis difficult.

Table 1: Pre-Entry Characteristics

	Status 1993					
	Left York		In Science		Other York	
	Count	Col %	Count	Col %	Count	Col %
Family Income 1992						
LE $49,999.....	11	40.7%	75	40.1%	2	20.0%
$50,000-$99,999.....	12	44.4%	81	43.3%	7	70.0%
GE $100,000.....	4	14.8%	31	16.6%	1	10.0%
Total.....	27	100.0%	187	100.0%	10	100.0%
Father College						
No College.....	19	54.3%	162	68.4%	8	66.7%
College Plus.....	16	45.7%	75	31.6%	4	33.3%
Total.....	35	100.0%	237	100.0%	12	100.0%
Mother College						
No College.....	26	72.2%	178	75.7%	10	83.3%
College Plus.....	10	27.8%	57	24.3%	2	16.7%
Total.....	36	100.0%	235	100.0%	12	100.0%
Member Of A Visible Minority Group						
No Minority.....	28	77.8%	176	75.5%	11	84.6%
Minority.....	8	22.2%	57	24.5%	2	15.4%
Total.....	36	100.0%	233	100.0%	13	100.0%

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that do exist, are not statistically significant.

With regard to self-identified minority group status, the majority of students, independent of enrolment status, are not members of a minority group. Although in the sample slightly more of those leaving York and remaining in Science, as compared to individuals going elsewhere in York, define themselves as minorities, differences are not statistically significant.

Although not shown in the table, it is also worth mentioning that independent of enrolment status in 1993-94, when students entered the University in 1992 there were no statistically significant differences in self-assessed preparation for university.

Overall, there are no striking differences among students with different enrolment statuses relating to their average family income, parents' education, visible minority status, or self-assessed preparation for university. In addition, as was seen when administrative data were examined, only slightly more females leave Science than stay, and more students for whom English is a second language leave for other York destinations than remain in Science or leave York entirely. Indeed, given that these data were drawn from administrative records, it can be argued that the pre-entry characteristic 'mother tongue' is the most important difference between on the one hand those who stay in Science or who leave York, and, on the other, students who end up in other York faculties. However, it is difficult to explain this finding.

Survey data collected on gender and language spoken in the home (not shown) show a similar pattern. As a result, we can be fairly confident that in terms of gender and mother tongue survey participants are typical of all students enrolling in first year science in 1992-93.

Goals and Commitments at York

Information presented in Table 2 indicates that in the September survey students who would migrate to other parts of York were more likely than those remaining in, or leaving, Science to say that York was their first choice of schools. In essence, there appears to be no logical connection between first choice of universities and retention/attrition. Differences, however, are not statistically significant; moreover numbers of students in column three are relatively few.

Table 2: Initial Goals and Commitments

	Status 1993					
	Left York		In Science		Other York	
	Count	Col %	Count	Col %	Count	Col %
First Choice of University						
Other	24	68.6%	167	70.5%	9	81.8%
York	11	31.4%	70	29.5%	2	18.2%
Total	35	100.0%	237	100.0%	11	100.0%
Intentions> Change Pgms Within This Univ						
Not Answered	27	75.0%	179	73.4%	8	61.5%
Answered	9	25.0%	65	26.6%	5	38.5%
Total	36	100.0%	244	100.0%	13	100.0%
Intentions> Same Pgm But Change Univ						
Not Answered	25	69.4%	187	76.6%	9	69.2%
Answered	11	30.6%	57	23.4%	4	30.8%
Total	36	100.0%	244	100.0%	13	100.0%
Intentions> Change Pgms And University						
Not Answered	26	72.2%	207	84.8%	12	92.3%
Answered	10	27.8%	37	15.2%	1	7.7%
Total	36	100.0%	244	100.0%	13	100.0%
Intentions> Leave Univ Before Complete						
Not Answered	32	88.9%	231	94.7%	13	100.0%
Answered	4	11.1%	13	5.3%		
Total	36	100.0%	244	100.0%	13	100.0%
Intentions> Do Not Know Exactly						
Not Answered	28	77.8%	212	86.9%	12	92.3%
Answered	8	22.2%	32	13.1%	1	7.7%
Total	36	100.0%	244	100.0%	13	100.0%
Important> Obtain Univ Degree/Diploma						
NotAtAll			3	1.2%		
Somewhat	4	11.1%	12	5.0%		
Very Important	11	30.6%	66	27.4%	3	23.1%
Extremely Important	21	58.3%	160	66.4%	10	76.9%
Total	36	100.0%	241	100.0%	13	100.0%
Important> Obtain York Degree/Diploma						
NotAtAll	20	57.1%	99	41.9%	6	46.2%
Somewhat	11	31.4%	90	38.1%	3	23.1%
Very Important	3	8.6%	33	14.0%	3	23.1%
Extremely Important	1	2.9%	14	5.9%	1	7.7%
Total	35	100.0%	236	100.0%	13	100.0%

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If other variables that fall in the goal and commitment category are examined a similar absence of a meaningful pattern is found. Table data indicate that in September 38.5% of individuals who would eventually change faculties at York indicated that they might change their programs within the university. The figures for those who would remain in Science and those who left the faculty were 26.6% and 25.0% respectively. While these figures indicate that in September those who would leave for other faculties at York were predisposed in that direction from the beginning of the first year, differences are not statistically significant.

When asked if they were likely to remain in the same program but change universities, in September roughly equal percentages - 30% - of students who would leave York or change faculties in York stated that this was a possibility compared to 23.4% of students who would remain in Science. Once again this may suggest a very slight preference for York leavers and Science leavers to entertain the possibility of change; however, differences are not statistically significant.

Similarly, in September, a greater proportion of eventual leavers stated that they might change programs and universities than those who stayed in Science or moved to other York faculties. Differences among groups, however, are not statistically significant.

When it comes to assessments in September of the possibility of leaving university before degree completion it is evident that the vast majority of students, independent of their enrolment status in the following Fall, did not see this as an option.

When queried on the importance of a university education, in the September survey, the majority of students in each group responded 'extremely important'. Those who would migrate to other York faculties scored highest in this regard while individuals who would leave York scored lowest. Particularly the latter finding is consistent with eventual leaving of York; however, after appropriate collapsing of categories and the application of the relevant statistical tests, differences among groups were found not to be statistically significant.

Finally, data in Table 2 indicate that in the September survey more students who eventually left York indicated that a York degree was not important at all than those who stayed in Science or who enrolled elsewhere in York. Differences, however, are not statistically significant.

Overall, on the basis of data collected in the September 1992 survey of entering students in the Faculty of Science, it is not possible to argue that the initial goals and commitments of students differ in accordance with their enrolment status one year later. In essence, explanations for enrolment statuses in 1993 cannot be found in initial goals and commitments of students in 1992.

Institutional Experiences at York - Academic Involvement

Information on academic involvement in 1992-93 was obtained from the mid-February/March survey conducted in 1993. Relations between various aspects of academic involvement, and enrolment status in the Fall of 1993, are summarized in Table 3.

The mean number of out-of-class contacts with faculty of ten minutes or more over the previous two months is highest for students who would stay in Science and lowest for those who migrate to other faculties. The mean for this group is 1.64 compared to 1.30 and .75 for students who would leave York and leave Science for other faculties at York respectively. While differences are not statistically significant, they are consistent with an initial expectation that academic involvement, as manifested in this case by contact with professors outside of class, is conducive to program retention.

Out-of-class contact with lab demonstrators is highest for students remaining in Science and lowest for those leaving for other York destinations. Means are 1.16 and .33 respectively. The mean for students who would leave York is .83. Once again, although not statistically significant, differences are consistent with the notion that academic involvement assists in student retention.

Data on contacts with staff are a little more difficult to interpret. The highest mean contact over the previous two months is for individuals who would go to other York faculties. The figures for this group and for those remaining in Science and leaving York respectively are 1.89, 1.36, and 1.13. Differences, however, are not statistically significant.

When asked how many academic or career activities individuals had participated in over the past two months, those who would remain in Science responded, on average, .76. The means for individuals leaving for other York destinations and students who would leave York were .70 and .23. Although differences are not statistically significant, once again they are consistent with the

Table 3: Academic Involvement

	Status 1993					
	Left York		In Science		Other York	
	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation
Contacts w/ Profs outside class.....	1.30	2.05	1.64	1.98	.75	1.04
Contacts w/ TAs outside class.....	.83	1.12	1.16	1.62	.33	.71
Contacts w/ York staff..	1.13	1.66	1.36	1.77	1.89	2.32
Number of outside academic activities..	.23	.43	.76	1.21	.70	1.34
Number of courses dropped.....	1.02	.66	.54	.68	.80	.79
Percent lectures per week.....	90.47	11.36	91.40	15.08	92.70	13.15
Percent labs per week...	99.29	3.78	95.91	17.73	90.00	31.62

Table 4: Satisfaction with Academic Involvement

	Status 1993					
	Left York		In Science		Other York	
	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation
Satisfaction.....	2.90	1.18	3.54	.92	2.80	.79
Satisfaction w/ Profs contact.....	2.90	1.05	3.20	1.01	2.89	1.36
Satisfaction w/ TAs contact.....	3.14	1.08	3.29	1.00	3.25	1.28
Satisfaction w/ staff contact.....	3.14	1.13	3.43	.93	3.56	.73
Satisfaction w/ instruction.....	2.63	1.07	2.97	.96	3.40	.70

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well-established fact that academic involvement is consistent with student retention.

Also consistent with the general relationship between academic involvement measured in various ways and retention is the finding that over the course of the year students who persisted in Science dropped the fewest number of courses, .54. The figures for students going elsewhere in York and leaving York were .80 and 1.02. Moreover, this time differences are statistically significant.

Other data displayed in Table 3 indicate that there are virtually no differences among the three groups under discussion in terms of lecture and laboratory attendance. For all groups, the mean rate of attendance is over 90% per week.

Overall, the data in Table 3 - the lack of statistical significance aside - are consistent with the notion embodied in Tinto's model that academic involvement is consistent with retention in Science. With regard to moving elsewhere in York or leaving the University entirely the data are less helpful. For example, those who would eventually leave York have higher rates of faculty contact than those simply going elsewhere in York. By way of contrast, those going to other York destinations have more contact with staff than either of the other two groups. These findings may suggest that academic involvement is important to an understanding of who stays in Science, but not to who leaves for other York faculties or who leaves the University.

Institutional Experiences at York - Satisfaction with Academic Involvement

Some of the data presented in Table 4 on satisfaction with various aspects of the academic program and academic involvement also are consistent with this general claim. For example, those remaining in Science in the Fall of 1994 had, in mid-February/March 1993, reported more satisfaction with the Science program, and with contact with professors and lab demonstrators, than students leaving York or those going elsewhere in the University. (Differences are statistically significant only for the first mentioned.) In short, program satisfaction and satisfaction with professors and laboratory instructors, as might be expected, are highest for individuals remaining in Science. For satisfaction with staff contact and with the quality of instruction, however, means are highest for those leaving for other York faculties. Differences, though, are not statistically significant.

Table 5: Social Involvement

	Status 1993					
	Left York		In Science		Other York	
	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation
Number of campus organizations..... **	.43	.90	.70	.85	.50	.71
Number of on-campus sports.....	.37	.67	.41	.69	.00	.00
Number of sports events watched.....	.57	1.10	.48	.91	.10	.32
Number of weekly pub visits.....	.37	.67	.43	.71	.00	.00
Number of new friends...	12.00	9.77	14.38	9.08	15.20	8.50
Hours/week with new friends.....	7.75	6.64	7.74	5.44	6.80	6.23
Hours/week on campus....	26.27	13.45	28.96	10.97	24.75	10.96

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Institutional Experiences at York - Social Involvement

In residential universities social involvement has been found to be related to student retention. Data presented in Table 5 deal with a number of possible operationalizations of this concept. Unfortunately, for none of the variables measuring social involvement are differences statistically significant. Just the same, for participation in campus organizations and sports, and for weekly visits to pubs, levels of involvement are higher for students who would remain in Science than for others.

Overall, on the basis of Tinto's model, it might be expected that academic involvement, satisfaction with various academic matters, and social involvement might be highest for individuals remaining in Science. While some of the data presented in this section are consistent with this expectation, because of exceptions for certain variables, and general lack of statistical significance, it would be misleading to suggest that variables falling in these categories, at York University, go far in explaining first year retention/attrition in the Faculty of Pure and Applied Science.

Emerging Goals and Commitments at York

Information on emerging goals and commitments, as measured in the mid-February/March survey, is outlined in Tables 6 and 7. Despite varying levels of statistical significance, overall patterns in the data are what might be expected. To begin, although not statistically significant, in Table 6, 60% of students who would migrate to other faculties stated that they might change programs. The figures for individuals remaining in Science and those leaving York are 31.0% and 33.3%. Similarly, although once again not statistically significant, 30.0% of those who would leave York, compared to 16.8% of those remaining in Science and none of the students ending up in other areas of York, stated that they might change universities.

If the possibility of changing programs and university is examined, it is clear that 46.7% of those leaving York, compared to 16.8% and none of the students remaining in Science or enroling elsewhere in York respectively, affirmed the possibility of this option. Similarly, 30.0% of those leaving York, compared to only 5.2% of individuals remaining in Science and none of those migrating to other faculties, stated that they might leave university before completing a degree. Moreover, for each of these two variables, differences are statistically significant.

Table 6: Emerging Goals and Commitments - A

	Status 1993					
	Left York		In Science		Other York	
	Count	Col %	Count	Col %	Count	Col %
Intentions: change program						
Not Answered	20	66.7%	160	69.0%	4	40.0%
Answered	10	33.3%	72	31.0%	6	60.0%
Intentions: change university						
Not Answered	21	70.0%	193	83.2%	10	100.0%
Answered	9	30.0%	39	16.8%		
Intentions: change program & university						
Not Answered	16	53.3%	199	85.8%	10	100.0%
Answered	14	46.7%	33	14.2%		
Intentions: leave before completing						
Not Answered	21	70.0%	220	94.8%	10	100.0%
Answered	9	30.0%	12	5.2%		

Table 7: Emerging Goals and Commitments - B

	Status 1993					
	Left York		In Science		Other York	
	Mean	Std Deviation	Mean	Std Deviation	Mean	Std Deviation
Continue science next fall	4.17	1.59	5.49	.82	3.30	2.11
Return to York U next fall	3.96	1.40	5.45	.79	6.00	.00

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Measured on a six point scale, where 1 meant extremely unlikely and 6 extremely likely, the data in Table 7 also are as might be expected. When asked how likely it was that they would return to Science in the Fall of 1993, in mid-February/March 1993, the mean scores for individuals who would remain in Science, move to other York locations, and leave York were 5.49, 3.30, and 4.17 respectively. When asked if they would return to York in the Fall, the scores for individuals remaining in Science was 5.45; for those migrating to other York faculties, 6.00; for students leaving York, 3.96. For the data in Table 7, differences are statistically significant.

Overall, for whatever reason, emerging goals and commitments, as measured in the Spring of 1993, are consistent with the enrolment status of students the following Fall. By way of comparison, in general, pre-entry characteristics and initial goals and commitments were of little value in explaining subsequent enrolment status. While institutional experiences - academic involvement and satisfaction; social involvement - were in some cases consistent with subsequent enrolment decisions, patterns were inconsistent and significance levels low.

Conclusion

Tinto's model has been applied in various studies of student retention. Frequently, the variables discussed in this report are used as independent variables in stepwise regression models with retention as a dichotomous dependent variable. When used in this way, as pointed out by Pascarella and Terenzini (1991), the model usually explains no more than about one quarter of the variance in student retention. (Other models explain no more.)

Unfortunately, although individuals such as Astin (1991; 1992) disagree, it is doubtful that stepwise regression can be used with a dichotomous dependent variable. Logistic regression is a more appropriate technique under such circumstances. When this technique was applied to the data discussed in this report, however, for reasons that need not be elaborated, it did not contribute to the understanding of the data. As a result, we are left with conclusions based on data analyzed earlier in this report.

Most obvious for these data is that at York the decision to remain in Science, to migrate to another York faculty, or to leave York, is not related to

students' pre-entry characteristics (excluding mother tongue) and initial goals and commitments. It is partly related to academic involvement (particularly to number of courses dropped and sessional marks). Satisfaction with academic involvement (excluding satisfaction with the Science program) and social involvement are not related to enrolment status. By way of comparison, several measures of emerging goals and commitments are related to enrolment status in the Fall of 1993.

What may be problematic for the Faculty of Pure and Applied Science is that as a group, students who migrated to other parts of York had the highest grade point averages in their first year of studies. Moreover, these students did not have pre-entry characteristics that predisposed them to leave; nor did they enter first year science with the intention of leaving at the end of the year. Nonetheless, something happened in first year so that by the end of term these students decided that Science at York was not for them.

Although their numbers are small, the level of achievement of this group of students is high. As a result, the Faculty may regret their decision to go elsewhere in York. Although the differences were not statistically significant, perhaps the relatively low (compared to students who remained in Science) level of academic involvement of these students was a factor in their eventual decision to leave. At this point we do not know. What we do know is that in both high school and first year university students who left Science had higher levels of achievement than those who remained in Science or who left the University. Nonetheless, while their decision to leave may be a loss to Science, it is a gain to other faculties at York.

More students than migrated to other York faculties left the University altogether. From administrative records we know that in terms of grades these students did slightly less well in grade 13, and much worse in first year, than students who remained in Science or who moved to other York faculties; nonetheless, 25% of students leaving York scored among the top half of first year Science students.

What is not known is why 75% of students leaving York display low levels of first year academic achievement. While it would be tempting to find an explanation in relatively low levels of grade 13 achievement, it should be remembered that in comparison with differences among groups in first year marks, differences in grade 13 results were very small.

It might also be tempting to attribute differences in first year outcomes discussed in this report to different standards among high schools. Unfortunately, this hypothesis cannot be tested with available data; however, data do exist demonstrating that when grade 13 marks are held constant, first year marks vary considerably by the school board in which the student completed his or her final year of high school. As a result, future research should focus on the interaction between the school board from which the student graduates and processes operative in the Faculty of Pure and Applied Science that elsewhere have been shown to influence a number of outcomes of the first year experience (Grayson, 1993a).

Appendix A: Model of Student Departure

Model of Student Departure

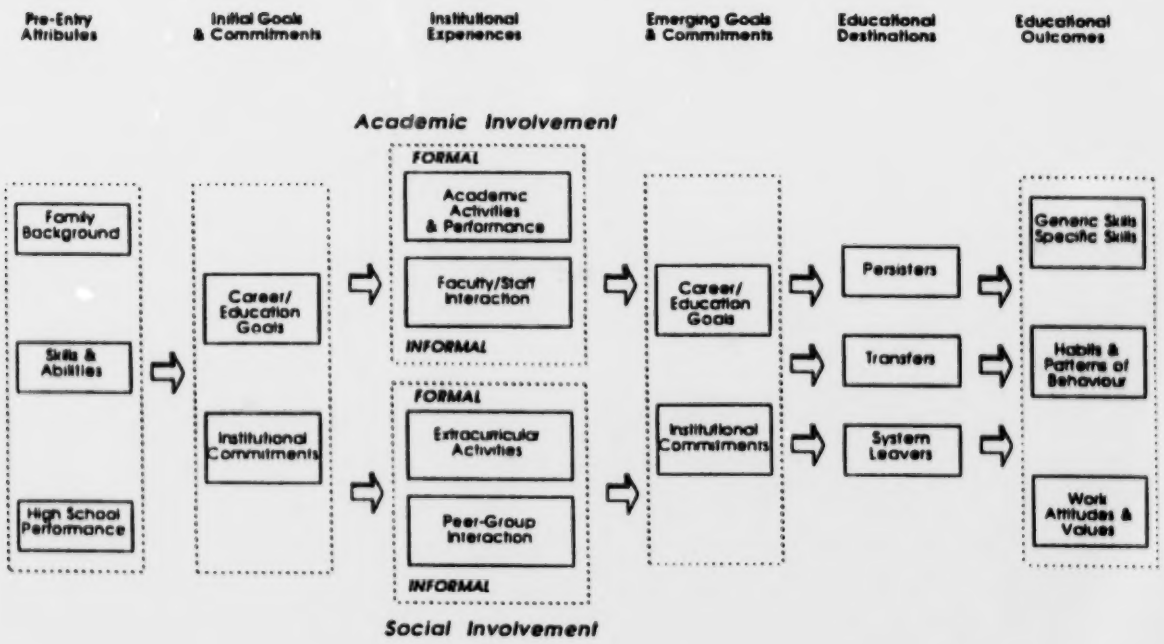
As shown in Figure A, according to Tinto's model of student departure, a decision to leave an institution of higher learning - outcome - is a function of four general sets of factors: pre-entry attributes of students; initial goals and commitments; institutional experiences; and changes in goals and commitments that may result from an interaction among the former.

While Tinto's model has been used in explications of student retention and attrition, it has also been applied to the study of other university outcomes. For example, Terenzini and Wright (1987) and Volkwein, King, and Terenzini (1986) have utilized it in examinations of student skill acquisition. Terenzini and Wright (1987) have also used the model in an examination of personal change. Theophilides, Terenzini and Lorang (1984) have studied major field changes employing the same model. Finally, at York University, with good effect, the general model has been used to explain a number of outcomes of first year Science such as satisfaction with marks, satisfaction with Science, and intellectual development (Grayson, 1993b).

The broad application of the model and its heuristic utility notwithstanding, it has limitations. To begin, the model gives insufficient attention to the facts that students have varying expectations of university life and normative expectations of peers, family, and other groups to cope with (Weidman, 1984, 1989; Weidman and Friedman, 1984; Weidman and White, 1985). In addition, students bring various concerns with them to the university context. "Am I smart enough to get good grades?" "How am I going to get enough money to cover expenses?" "If I don't do well my parents are really going to be upset." Such expectations and concerns may be present at entry and may mediate the impact of various institutional experiences. For example, with regard to expectations, net of pre-entry characteristics and goals and commitments, if an entering student has totally unreasonable expectations regarding the amount of individual attention he or she will receive from faculty, the impact of institutional experiences is bound to be negative. Similarly, an excessive preoccupation with failure and its consequences may affect negatively the way in which students experience university life.

It should be noted also that the model is based primarily on research on white American full-time students enroled in residential colleges and universities. This focus represents a limitation to the extent that, for example, it has been shown that at commuter universities such as York, academic achievement is more important in explaining institutional persistence than in residential universities

Figure A: Model of Student Departure



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(Costa, 1984; Dietsche, 1990; Fox, 1986; Garcia, 1988; Grayson, 1993a). Similarly, social integration has been found to have little relation to institutional persistence in commuter as compared to residential settings (Braxton and Brier, 1989; Carter, 1982; Williamson and Creamer, 1988). Despite limitations such as these, the model remains a convenient heuristic device in accordance with which differences between residential universities and commuter universities, like York, can be examined.

Pre-Entry Attributes and Goals and Commitments

Many studies have demonstrated that students with parents who have post-secondary education; individuals who have developed various skills and abilities (e.g. high marks and communication and time management skills); and students who have high grades in the final year of high school, are less likely than others to withdraw from the institution of initial enrolment (see Tinto, 1987 for an elaboration). For present purposes it is not necessary to explain the dynamics underlying these findings. What does warrant some clarification are the potential impacts of gender and visible minority group status on retention and other university outcomes.

With regard to the latter, Tinto (1987:72) notes that little attention has been paid to the impact of gender on university retention. While he stops short of postulating that the nature of female students' experiences would lead to higher attrition rates than for males, he nonetheless acknowledges that female experiences in institutions of higher education likely are different from those of men. In this belief he is backed up by the work of others. For example, Hall and Sandler (1984) argue that female students: must often deal with the expression of stereotypical roles of women in the classroom; are frequently interrupted when giving responses to questions; often have their names forgotten to a greater extent than male students; and receive less verbal and other support than males in academic endeavours. The net effect is a 'chilly climate' for female students. In addition, Whitmore (1987) found that female students have less intellectual self-confidence than males with similar abilities.

In a previous report based on students in Science at York University it was found that female Science students had less self-confidence than males. Nonetheless, in the same report it was mentioned that although the experiences of female students in first year Science may be worse than those of their male class-mates, females believed that they were treated the same as males by other

students, faculty, and staff; moreover, the grade point averages of female students did not differ from those of males (Grayson, 1993b).

With respect to students who are members of visible minorities (at least in the United States), Tinto notes that all else being equal, such students are more likely than others to feel marginalized. As a result, their chances of premature departure are enhanced. In this respect they are similar to other campus groups whose circumstances are different from the norm. That visible minority students may also feel intimidated by participation in institutions of higher learning is noted by Pounds (1989:278). At York University, however, while self-identified visible minority students entered their first year of science with relatively low self-confidence and low expectations, by the end of the year they were no different than other students on these dimensions; in addition, the grade point averages of first year minority students were the same as those of other students (Grayson, 1993b).

With regard to 'goals and commitments', net of pre-entry characteristics, students who place a high value on education and have an initial commitment to the institution as a way of realizing these goals are less likely to withdraw than other students.

Institutional Experiences

Once enroled, 'institutional experiences' have the potential to affect student outcomes. More specifically, colleges and universities provide various opportunities conducive to: academic performance (high quality teaching, mentoring, etc.); faculty/staff interaction with students (e.g. the opportunity outside of class to discuss various personal and academic matters); extracurricular activities (sports, clubs, and so on); and peer-group interactions (e.g. facilities and times conducive to informal gatherings where problems may be discussed and social cohesion enhanced). These possibilities sum to varying degrees of academic and social involvement as portrayed in Figure A.

Emerging Goals and Commitments

Depending on their nature, controlling for pre-entry characteristics and initial goals and commitments, institutional experiences may modify or reinforce initial educational goals and/or institutional commitments as in Figure A. For

example, negative institutional experiences, such as poor teaching, may lead students with an entering A average and an initial commitment to the institution to re-evaluate their long term educational objectives and choice of universities. Conversely, as a result of positive experiences, like good teaching, students with entering grades of B and little commitment to the institution may excel in their studies; consequently, they may re-evaluate their original negative commitment to the institution. In the former case, the outcome may be a decision to transfer or to leave the education system entirely; in the latter, a decision to stay.

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